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Long-term trends in Northern European Storminess since 1850

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Due to the shortness and/or the inhomogeneities contained in direct wind observations, evidence for changing storminess is mostly based on indirect data or reanalysis products. While reanalysis products generally show upward trends in high annual wind speeds for the last 40-60 years, direct local wind observations show different trends for Northern Europe dependent on the location and the considered time period.

Independent from discrepancies among direct wind observations or reanalysis, the question whether storminess has indeed changed over longer timescales over the NE Atlantic and NW-Europe has been examined by multiple studies coming to different results. Reconstructions of annual storminess derived from pressure readings generally agree in showing no robust long-term trends for the last 150 to 200 years over NW Europe to central Sweden. In contrast, significant upward trends in annual storm activity since 1871 has been recently derived from the 20th century reanalysis (20CR) which only assimilates sea-level-pressure and monthly mean SST and sea-ice. As the inconsistency between 20CR storm activity and storminess derived from pressure readings increases further back in time, the decreasing station density assimilated in 20CR might be one reason to explain inconsistencies in the upward trend of storm activity in 20CR compared to other reconstructions.

While the reason for this inconsistency cannot be evaluated based on reconstructions, we use a different statistical method to reconstruct historical storminess for the period 1850-2009. Daily station SLP is used to estimate the highest pattern similarity between days in the past since 1850 with days in the observational period 1958-2007. For this 50year period, corresponding atmospheric fields like SLP and wind are known from a reanalysis driven regional climate simulation. Based on the pattern similarity regarding station SLP, these fields are redistributed back to 1850 to complete the reconstruction of atmospheric fields. As this upscaling approach makes no other assumptions than that of similarity of SLP patterns, the reconstructed storminess is independent from other reconstructions.

The validation of the reconstructed seasonal wind speeds with NCEP shows very high agreement regarding correlation and variability with exception of summer. The derived high annual percentiles of wind speed of our reconstruction shows large decadal variations with peaks in storminess in the 1880s and at the end of the 20th century with an unusually calm period in the 1960s. Hence, the reconstruction fully supports earlier reconstructions based on pressure readings and confirms the inconsistency in the long-term upward trend in 20CR regarding storm activity. Similar to other reconstructions, the inconsistency of 20CR regarding positive trends in storminess can be mainly attributed to opposite storminess conditions in the early period of 20CR i.e. around 1880. In this period, 20 CR shows very calm conditions with in contrast very stormy conditions in reconstructions based on station SLP. As our reconstruction uses an increasing station density over time like in 20CR, an additional reconstruction will be applied using only six stations being kept constant over the whole period in order to assess a possible sampling effect on the reconstructed long-term variability of storminess in the presented reconstruction.